

# Undersea Warfare Science & Technology

*Enabling Strategic Innovation for the Undersea Force*

## Strategy 2016



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# Executive Endorsement



A handwritten signature in black ink, reading "J E Tofalo", written over a horizontal line.

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# Forward

The Undersea Warfare (USW) Science & Technology (S&T) Strategy describes the USW Enterprise's objectives for influencing the focus of Naval Research & Development Establishment (NR&DE) S&T investments and how these investments are aligned to current USW doctrine, such as the Commander, Submarine Force's (COMSUBFOR) Commander's Intent for the U.S Submarine Force and Supporting Organizations and the Office of the Chief of Naval Operations (OPNAV) Director, Undersea Warfare Division (N97) Integrated Undersea Future Investment Strategy (IUFIS).

This strategy defines ten USW S&T capability focus areas:

1. Assure Access to Maritime Battlespace (AA)
2. Autonomy and Unmanned Systems (AUS)
3. Undersea Maneuver Warfare (UMW)
4. Expeditionary & Irregular Warfare (EIW)
5. Information Dominance & Cyber (IDC)
6. Platform Design & Survivability (PDS)
7. Power and Energy (PE)
8. Strike & Integrated Defense (SID)
9. Warfighter Performance (WP)
10. Undersea Precision Navigation and Timing (UPNT)

This USW S&T Strategy serves three principal purposes:

- (1) Communicating USW S&T Strategy to the NR&DE, senior decision makers and developers,
- (2) Defining the role of the USW Chief Technology Officer, and
- (3) Describing how the USW S&T strategy will be implemented

This USW S&T Strategy will continue to strengthen the USW Enterprise's technological superiority, enable current and future readiness, and sustain affordable modernization.



*"Throughout our history the Navy and Marine Corps have been agile, innovative, and adaptable, ensuring global stability and American prosperity. With increasing complexity and shrinking budgets, now is the time to remove barriers and foster a culture of innovation that unleashes the ingenuity intrinsic in our people. Innovation has been our tradition and it must also be our future."*

**Ray Mabus**  
**Secretary of the Navy**

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# Introduction

The Undersea Warfare S&T Strategy describes how Undersea Warfare S&T priorities are established and guides strategic S&T investments. The Strategy provides guidance to facilitate the alignment of available S&T investments with capability requirements. The guidance in this document provides S&T investment priorities to Naval Research & Development Establishment (NR&DE), other government agencies and industry.

This strategy aligns with Department of Defense S&T Priorities, the Naval S&T Strategy, and reflects Commander, Submarine Force's (COMSUBFOR) Commander's Intent for the U.S Submarine Force and Supporting Organizations and the Office of the Chief of Naval Operations (OPNAV) Director, Undersea Warfare Division (N97) Integrated Undersea Future Investment Strategy (IUFIS).

This document replaces the Undersea Warfare S&T Strategic Plan dated 10 FEB 2010. The Undersea Warfare S&T Strategy will be reviewed and/or revised quadrennially, or as required, to address lessons learned, evolving warfighter needs, and emerging technology opportunities.

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*“Taking risks and being willing to fail to progress is imbued in the innovative community and we have to try to imbue our [DoD] folks with the same kind of spirit – [to] go out there and try something new.”*

**Ashton Carter**  
**Secretary of Defense**



# USW S&T Strategy & Implementation

## STRATEGIC FOCUS

At the Vice CNO level, the 2015 Naval S&T Strategy centers on nine S&T Focus Areas based on overall Naval capability needs. Similarly, the USW S&T Focus Areas are organized into focus areas spanning USW capability needs with alignment to Naval Focus Areas.

The 2015 USW S&T Focus Areas are listed below. Due to the unique nature of submarine operations, there are some unique areas of technology development that must be addressed to fulfil the future undersea vision. There are 8 USW S&T Focus Areas that directly align with the current Naval S&T Strategy, however, the USW enterprise has chosen to add two additional focus areas that have direct relevance to the future of USW. The USW S&T Focus Areas that differ from the Naval S&T Strategy are highlighted in bold below.

### 2015 USW S&T Focus Areas:

1. Assure Access to Maritime Battlespace (AA)
2. Autonomy and Unmanned Systems (AUS)
- 3. Undersea Maneuver Warfare (UMW)**
4. Expeditionary & Irregular Warfare (EIW)
5. Information Dominance & Cyber (IDC)
6. Platform Design & Survivability (PDS)
7. Power and Energy (PE)
8. Strike & Integrated Defense (SID)
9. Warfighter Performance (WP)
- 10. Undersea Precision Navigation and Timing (UPNT)**

- **Undersea Maneuver Warfare (UMW)** - The UMW Focus Area directly addresses the need to develop capabilities that not only allow undersea forces to operate in their traditional roles and missions, but to expand their capabilities to counter emerging enemy undersea warfare capabilities related to sea-bed operations, sensor deployment, unmanned systems and undersea infrastructure.
- **Undersea Precision Navigation and Timing (UPNT)** - The UPNT Focus Area directly addresses the increasing concern regarding the threat that anti-access and area denial (A2AD) poses and how undersea forces will need to maintain precision navigation accuracy in order to perform current and emerging missions.

The Undersea Warfare S&T Strategy supports the Naval and USW strategic foci and is supported by USW S&T Objectives (STOs) that guide available S&T development investments with the future technology requirements of Undersea Warfare. The COMSUBFOR Commander's Intent for the U.S. Submarine Force and Supporting Organizations and the Integrated Undersea Future Investment Strategy (IUFIS) serve as the foundation for the Undersea Warfare S&T Strategy and the STOs.

### COMSUBFOR Commander's Intent

In his Commander's Intent, COMSUBFOR emphasizes above all else that the undersea force must continue to own the undersea domain. In addition, COMSUBFOR asserts:

- Undersea forces operate far forward, are persistent and covert,
- Non- provocative influence from under the sea can deter and de-escalate potential conflicts by providing cross-domain intelligence, real-time warning to U.S. leadership, and rapid transition from peacetime if required, and
- Undersea forces are the anti-A2AD force, operating inside adversary defenses, using our access to set the table for the joint force, exercising stealth and surprise at the time and place of choosing.

COMSUBFOR's Commander's Intent identifies four lines of effort (LOE):

- 1. Provide Ready Forces**
- 2. Employ the Force effectively**
- 3. Develop Future Capabilities**
- 4. Empower our People, the Foundation of our Strength.**

Adhering to the Commander's Intent, the primary focus of the USW S&T Strategy and the subsequent S&T Objectives is mainly on LOE 3: Develop Future Capabilities. Additionally some elements also apply to improving LOEs 1, 2 and 4.

The extent of the future undersea warfighting environment is unknown but the undersea force is leading the way with developing innovative concepts and processes. The goals are to develop future capabilities that will allow the Undersea Force to: (Figure 1.)

- **Own the Best,**
- **Beat the Adversary's Systems,**
- **Grow Longer Arms,**
- **Protect Our Strategic Assets...and Threaten Theirs**
- **Be the Best,**
- **Get on the Same Page,**
- **Get Faster**

The below concepts and processes will guide the development of new technology and allow the force to adapt quickly to the future threat environment.

Increased emphasis on non-kinetic and non-lethal.

- The VIRGINIA Payload Module is literally the doorway to an exciting future of new kinetic and non-

kinetic payloads that will ensure we “grow longer arms,” “beat the adversary’s system,” and both “defend our strategic assets...and threaten theirs.”

“Get faster” - USW is leading in innovation with:

- Undersea Rapid Capabilities Initiatives (URCI)
- Theater ASW Offset Strategy initiatives

Forging new ground in the area of acoustic superiority:

- New sensors, coatings, and quieting techniques.

Heavyweight torpedoes production restart

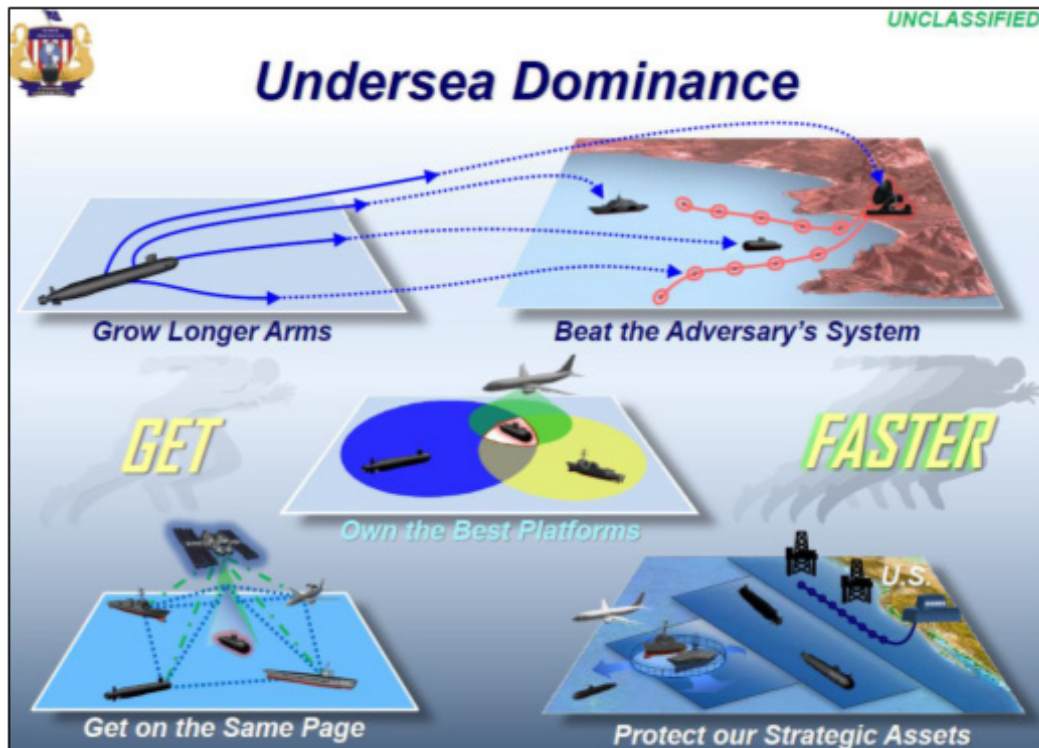


Figure 1: COMSUBFOR Undersea Dominance Goals

### Integrated Undersea Future Investment Strategy (IUFIS)

The Integrated Undersea Future Investment Strategy (IUFIS) is OPNAV N97’s internal guidance on the “means” to achieve the strategic objective in COMSUBFOR Commander’s Intent LOE 3: Develop Future Force Capabilities – Prepare for future operations and warfighting. It is a description of the intended broad capability objectives to be achieved and the general means by which those aims are to be accomplished. It is coordinated with and consistent with the National Security Strategy, the National Military Strategy, the Cooperative Maritime Strategy, and guidance from COMSUBFOR and is designed to help guide investment in technology and capabilities for undersea forces.

The Undersea Warfare S&T Strategy and subsequent STOs are also aligned to the IUFIS and serve as the source of direction for the NR&DE to develop concepts and capabilities that will allow the



undersea force to achieve COMSUBFORs goal of continuing to own the undersea domain. As identified by OPNAV N97, some elements of the strategy are “stretch goals” which guide priorities and approach while developing future undersea warfare programs. The IUFIS describes the need for technology and capability development based on the following four areas:

- 1. Inherent Advantage of the Undersea Force**
- 2. Growing Demand for Undersea Capability**
- 3. The Shrinking Undersea Force**
- 4. Providing Greater Value with Fewer Submarines**

In order to execute the strategy, the IUFIS adheres to the following attributes:

- **An Integrated, Realistic Strategy:** The undersea strategy must be integrated, solving problems in a coordinated manner rather than one by one. The plan must identify the timing of key decisions and pinpoint what must be done when, in order for the plan to work. Finally, to be effective the plan must be fiscally responsible and technically executable – that is, it must fit within budgetary constraints, industrial capacity, and practical timelines.
- **Stability in the Strategy, Flexibility in the Execution:** The IUFIS provides a coordinated investment approach for sustaining U.S. advantages in exploiting the undersea for our national security. Our priorities and progress require careful coordination across the Submarine Force and associated support organizations to achieve success. We must prioritize proposed investments to responsibly fill as many gaps as possible within fiscal reality. Our current priorities are listed below:

The IUFIS identifies investment opportunities in the undersea domain, aligned with the five core competencies of the Cooperative Strategy for 21st Century (CS-21R) as follows:

- **Deterrence:** Provide a survivable, effective and sufficient sea-based strategic nuclear deterrent
- **Sea Control / Assured Access:** Provide undersea forces capable of controlling the sea at the time and place of our choosing and seize the offensive initiative early in any conflict.
- **Power Projection:** Provide robust ability to strike targets with surprise from undersea, including time sensitive targets and those with particular value within an Air-Sea Battle context.
- **Maritime Security:** Provide a sustained undersea ability to insert, support and extract Special Forces.
- **Humanitarian Assistance/Disaster Relief:** Sustain a global undersea rescue capability that is available to our allies and friends.

### Organizational Roles in Support of USW S&T Strategy

The USW Future Capabilities Organizational Construct (Figure 2.) identifies the major activities involved in developing and delivering USW capability and the organizational structure that will

oversee and coordinate all aspects of near-term to far-term capability development for the undersea warfighter.

The Undersea Warfare Board of Directors (USW BOD) is the executive level body of Flag and Senior Executive Service (SES) stakeholders involved with optimizing the delivery of current and future submarine readiness. The USW BOD provides the overarching governance in which the Future Capabilities Organizational Construct functions.

The major activities involved will provide disciplined and focused governance to develop future USW technology concepts, prioritize USW capability needs, guide and coordinate S&T and research and development (R&D) investment, identify non-propulsion modernization requirements and ensure technology solutions are aligned to meet USW requirements and provide USW capability to the warfighter. The major governance groups involved are:

- Undersea Warfare Chief Technology Officer (USW CTO)
- Future Capability Group (FCG)
- Transition Advisory Board (TAB)
- Submarine Tactical Requirements Group (STRG)
- Submarine Information Technology Governance Group (SITG)
- Submarine Modernization Group (SMG)

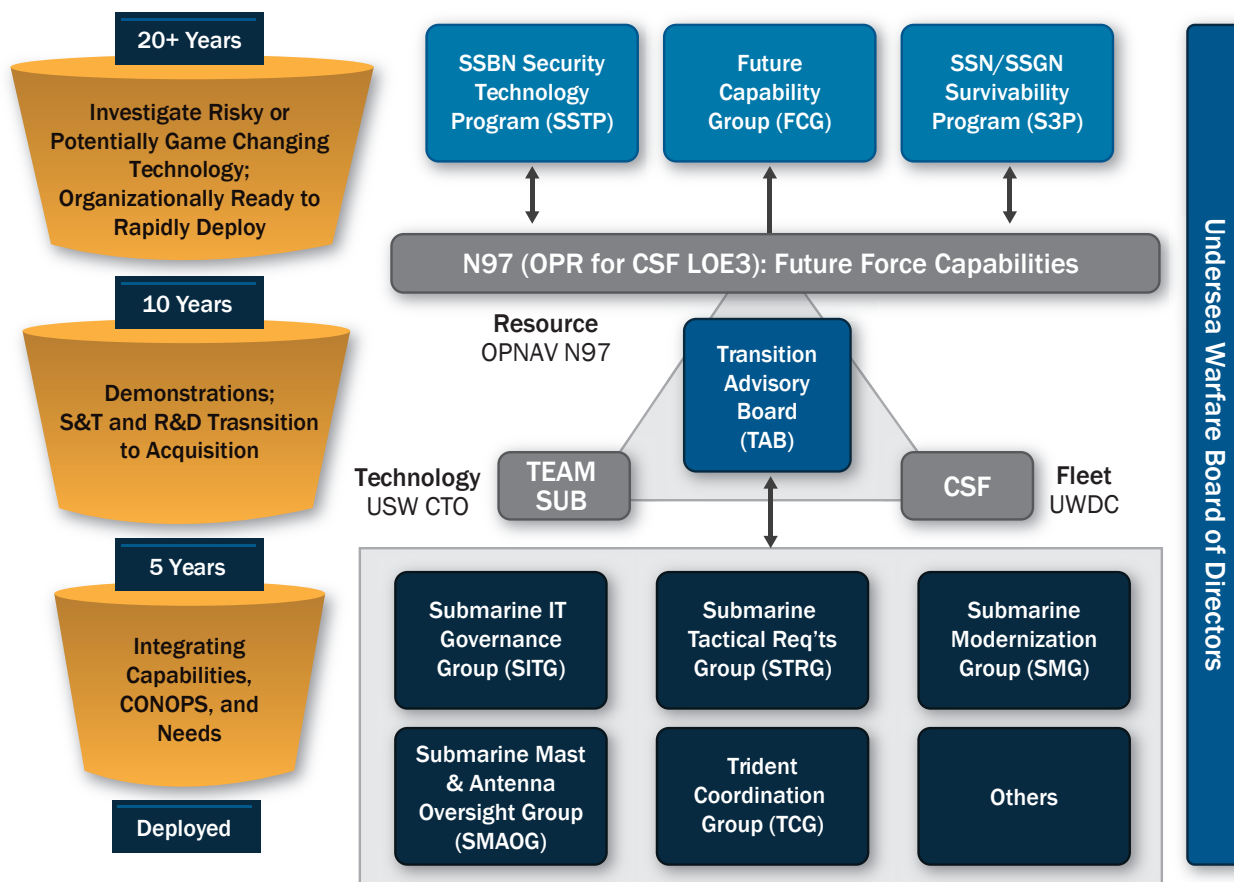


Figure 2: USW Future Capabilities Organizational Construct

## IMPLEMENTATION

As directed by COMSUBFOR, the USW CTO oversees the implementation of the Undersea Warfare S&T Strategy and the development of the USW STOs.

The Commander, Submarine Forces (COMSUBFOR) established the Undersea Warfare Chief Technology Officer (USW CTO) to understand, influence, and align Undersea Warfare (USW) Science and Technology (S&T) efforts to ensure S&T investments are properly balanced to meet near, mid and far-term capability needs.

The USW CTO strategic implementation activities are outlined in the tasking promulgated by Commander, Submarine Forces (COMSUBFOR). This letter directs the USW CTO to:

1. Serve as a member of the Undersea Domain (USD) Transition Advisory Board (TAB) and deliver to the USD TAB developed S&T objectives aligned with Chief of Naval Operation's guidance and Commander Submarine Forces Undersea Domain Campaign Plan for USD TAB endorsement to COMSUBFOR.
2. Maintain a healthy and vibrant relationship with Chief of Naval Research (CNR) and Director of Defense Advanced Research Projects Agency (DARPA).
3. Evaluate progress of ongoing S&T efforts by comparing progress with desired results and managing transitions with resource sponsors and acquisition program offices.
4. Conduct periodic reviews to evaluate and balance S&T investments.
5. Leverage S&T efforts across the Navy to realize capability needs affordably.
6. Perform other duties, related technology efforts, as assigned.

*“Innovation is much more than new technology. Innovation requires a healthy process driven by bold entrepreneurs committed to rapid fielding of new capabilities and improving the effectiveness of legacy systems to maximize warfighting excellence.”*

**Sean Stackley**  
**Assistant Secretary of the Navy**  
**for Research, development and Acquisition**



Table 1 describes, in detail, the mechanism(s) that the USW CTO and staff will use to ensure execution of COMSUBFOR tasking.

COMSUBFOR Tasking	USW CTO Implementation
<b>Serve as member of the Undersea Domain (USD) Transition Advisory Board (TAB) and deliver to the USD TAB developed S&amp;T Objectives (STOs) aligned with the CNO's guidance, COMSUBFOR Commander's Intent and OPNAV N97 IUFIS for USD TAB endorsement to COMSUBFOR.</b>	<ul style="list-style-type: none"> <li>• Execute a biennial review and update the USW STOs. The STOs will be published every other Fall (odd years) to influence S&amp;T program shaping.</li> <li>• Develop a USW S&amp;T Strategy, Objectives &amp; Needs brief to communicate with industry, academia, and government organizations to guide their investments and research. Take advantage of government/industry outreach forums to communicate the strategy and objectives.</li> </ul>
<b>Maintain a healthy and vibrant relationship with Chief of Naval Research (CNR) and Director of Defense Advanced Research Projects Agency (DARPA)</b>	<ul style="list-style-type: none"> <li>• Host an annual USW S&amp;T Executive Engagement Day (STEED) to ensure alignment of future technology development efforts with USW strategic vision and warfighter needs. Minimum topics shall be USW principals update, review/discussion of current/proposed efforts by ONR and DARPA and discussion of future USW technology focus areas and the research that must be maintained or begin to support those focus areas.</li> <li>• Leverage ONR Global Technology Awareness (GTA) Program: USW CTO will provide ONR Global with priority USW S&amp;T Global Technology Awareness study topics as required and attend USW applicable quarterly GTA reviews with CNR.</li> <li>• Maintain and consider increasing USW details/rotational assignments at ONR and DARPA to maintain continuity of focus on USW S&amp;T objectives.</li> </ul>
<b>Evaluate progress of ongoing S&amp;T efforts by comparing progress with desired results and managing transitions with resource sponsors and acquisition program offices</b>	<ul style="list-style-type: none"> <li>• Provide USW S&amp;T gaps to OPNAV early in the OPNAV N84 S&amp;T capability gap definition process (typically every Spring). USW CTO will provide USW S&amp;T gaps to OPNAV N84 in collaboration with OPNAV N97 and COMSUBFOR.</li> <li>• Maintain USW CTO webpage to increase industry access to USW S&amp;T Strategy, Objectives and priorities and POCs.</li> <li>• Coordinate with the Office of Naval Intelligence (ONI) to conduct an annual technology surprise intelligence assessment to inform USW leadership.</li> <li>• Generate quadrennial update to the USW S&amp;T Strategy.</li> </ul>



COMSUBFOR Tasking	USW CTO Implementation
<b>Conduct periodic reviews to evaluate and balance S&amp;T investments</b>	<ul style="list-style-type: none"> <li>The USW CTO will conduct an annual Portfolio Health Assessment (PHA) of the USW S&amp;T Portfolio to evaluate transition health, strategic engagement shortfalls, technology readiness, cost &amp; schedule, and identify issues that require USW CTO attention. The PHA will also include an evaluation of the ROI and recommend re-balancing the portfolio as required.</li> </ul>
<b>Leverage S&amp;T efforts across the Navy to realize capability needs affordably</b>	<ul style="list-style-type: none"> <li>USW CTO will meet with Naval Enterprise CTOs, at least annually, to plan aforementioned workshop, assess collaborative opportunities and share knowledge.</li> <li>Maintain the USW S&amp;T Strategic Engagement Tempo to provide inputs to OPNAV S&amp;T gaps and shape future NR&amp;DE investments.</li> <li>Utilize USW STOs and PORs to identify specific S&amp;T/R&amp;D needs.</li> <li>Work with technology providers to scope projects that will mature technologies to meet those needs.</li> <li>Communicate specific S&amp;T/R&amp;D needs through existing process (e.g., OPNAV Technology Gaps) as well as directly to technology providers.</li> <li>Identify areas where investment would accelerate fielding capabilities to the Fleet.</li> <li>Leverage all available sources of S&amp;T/R&amp;D funding to mature technologies</li> <li>Monitor transition of technology into USW POR. Communicate risks associated with delaying transition or altering funding profiles.</li> </ul>

*Table 1: COMSUBFOR Tasking and USW CTO Directed Actions*

## Science & Technology Objectives

Bienially, the USW CTO conducts USW STO development workshops with all relevant stakeholders. The input is assessed and collated to produce the USW S&T Objectives document. The USW STOs represent the long term S&T goals to support Undersea Warfare and are used as the baseline for identifying, prioritizing, aligning, and synchronizing S&T investment efforts. They represent a broad range of foci that provide direction for the future while retaining sufficient flexibility to allow the S&T community to meet emerging challenges.

## Enduring Focus on Affordability

The USW force agrees that total ownership cost is critical to maintaining existing undersea capabilities and in developing future systems, but will become even more important in the decades to come. Expanding unrest in the world coupled with anticipated reduction in the Defense budget will necessitate that each and every individual in the technology development process always keep the underlying theme of affordability in mind. Both in the USW S&T Strategy and the USW STOs, the reader will see that affordability is pervasive across all of the USW S&T focus areas.

*Affordability concerns should always influence the way government and industry designs, develops, manufactures, maintains and disposes of our myriad undersea systems.*

## Leveraging International Cooperative R&D

In order to leverage the limited S&T funds available for future development of the undersea force, we must strive to enhance U.S. Navy, specifically USW, R&D capability through partnerships with international allies via R&D Data and Information Exchange Annexes (DEAs/IEAs) and through formal Cooperative Developments efforts.

To do this, the USW CTO shall continue to forge relationships with international technical project officers (TPOs) & senior allied military partners regarding the exchange of research data and information, for areas/technologies of benefit to the US naval force, including undersea forces; in conjunction with other Defense agencies (OSD, OPNAV, ONR, NIPO)

## USW S&T Portfolio Health Assessment

The effectiveness of the USW STOs at shaping USW S&T investments and aligning to the USW S&T Focus Areas will be evaluated annually through an assessment of the health of the USW S&T investment portfolio. The portfolio health assessment will identify S&T areas that are weak and need to be addressed, S&T areas of opportunities that should be exploited, and S&T areas with emerging capability requirements. The assessments will influence decisions related to initiation, continuation or termination of areas of investment to include rebalancing of the USW S&T portfolio. The assessment will cover:

- Projects that have transitioned since the last assessment

- Projects that are currently in execution
- Projects under development and consideration for funding
- STO health

Projects that recently transitioned will be evaluated by the following criteria:

- Technical maturity of system and components
- Alignment of project to STOs
- Project funding including comparison with funds committed in transition agreement

Projects that are in execution will be evaluated by the following criteria:

- Technical maturity of system and components
- Alignment of project to STOs
- Advocacy of project within Program Office, User Community, and Resource Sponsor
- Project funding
- Ability to transition to next level of S&T or R&D funding; specifically state of the transition agreement and transition funding

Proposed projects considered for funding will be evaluated by the following criteria:

- Alignment of project to STOs
- Advocacy of project within Program Office, User Community, and Resource Sponsor

STO health will be evaluated by the following criteria:

- Number and health of projects supporting the progress towards satisfying capability needs
- Technical capability within government labs and academia to address STOs

The organizations participating in the execution of the USW S&T Strategy and their respective roles and responsibilities are summarized in this section. Successful execution of the plan requires engagement activities that effectively and efficiently close capability gaps while optimizing collaboration within the NR&DE, with other services and government agencies and with the global S&T community.

#### USW S&T Facilitation

The USW CTO provides direction to and relies on the USW CTO Staff as the S&T facilitator of new technologies across the NR&DE. USW CTO supports USW leadership by executing tasks as assigned and specifically by:

- Pursuing new technologies that address USW articulated needs at a reasonable cost within a realistic timeframe
- Ensuring USW technology plans and needs are communicated across the S&T/R&D communities
- Facilitating a common focus across S&T/R&D communities to provide solutions aligned with USW articulated needs
- Participating in negotiations for new technology development to maximize return on investment (ROI) and likelihood of transition to USW R&D programs

- Monitoring USW R&D programs, identifying key development milestones, conducting periodic assessment of the progress and providing recommendations for continued development or termination of the investment
- Identifying applicability of new technologies to appropriate PEO and Program Offices for incorporation into programs of record
- Assisting with the development and coordination of transition strategies for fleet insertion

The USW S&T Strategic Plan seeks to leverage the S&T activities of key managers and organizations as summarized in the following paragraphs.

- Assistant Secretary of the Navy for Research, Development and Acquisition (ASN (RDA)) - Serves as the Navy Acquisition Executive and has authority, responsibility and accountability for the development and acquisition of platforms and weapon systems.
- Office of the Chief of Naval Operations (OPNAV) - Responsible to the Secretary of the Navy for the command, utilization of resources and operating efficiency of the operating forces of the Navy and of Navy shore activities. The OPNAV organization allocates the resources to support the transition of S&T products to a Program of Record.
- Naval Sea Systems Command (NAVSEA) - Develops, delivers and maintains ships and systems for the United States Navy. NAVSEA provides the executive leadership for developing and executing the USW S&T strategy as designated by COMSUBFOR.
- Program Executive Offices (PEOs) - Develop, acquire, modernize, and maintain US Navy Submarines and Undersea Systems. PEOs provide managers who are responsible for planning transitions of S&T to acquisition programs.
- Commander, Submarine Force (COMSUBFOR) - Operate, maintain, train, and equip submarines in support of Fleet and National tasking. COMSUBFOR is a single voice for submarine readiness requirements, operational and technical needs, providing the USW Future Capability Vision and tasking the USW CTO to develop and update the USW S&T strategy.
- Warfare Center Chief Technology Officers (CTO) - Serves the Commander, Technical Director and Technical Operations Manager as primary technology advisors for S&T related matters. The CTOs maintain and communicate their warfare centers' technical vision. The Naval Undersea Warfare Center (NUWC), Naval Surface Warfare Center (NSWC) and Space & Naval Warfare Systems Command (SPAWAR) are the primary contributors in support of the USW S&T Strategic Plan.
- Defense Advanced Research Projects Agency (DARPA) - Prevent technological surprise against the U.S. while creating technological surprise against the Nation's potential adversaries. DARPA accomplishes its mission by sponsoring revolutionary, high-payoff



research that bridges the gap between fundamental discoveries and their military use. The USW CTO will maintain a healthy and vibrant relationship with DARPA to achieve game-changing technologies in support of the USW S&T strategy.

- Office of Naval Research (ONR) - The Department of the Navy's (DON) S&T provider. ONR mission is to plan, foster, and encourage scientific research in recognition of its paramount importance as related to the maintenance of future naval power, and the preservation of national security. Further, ONR manages the Navy's basic, applied, and advanced research to foster transition from science and technology to higher levels of research, development, test, and evaluation. The USW CTO will maintain a healthy and vibrant relationship with ONR and ONR Global to achieve future capability visions in support of the USW S&T Strategy.
- Office of Naval Intelligence (ONI) - Produces and rapidly distributes meaningful maritime intelligence to key strategic, operational, and tactical decision-makers. ONI is a core element of Global Maritime Intelligence Integration whose goal is complete Maritime Domain Awareness. ONI influences USW S&T needs by providing the USW CTO and USW leadership with information related to threat capabilities and potential technology surprises.
- Undersea Warfare Chief Technology Officer (USW CTO) - In addition to its USW S&T facilitation role, the USW CTO is responsible to the USW Board of Directors (USW BOD) for assuring a continuing stream of affordable and effective new technologies for insertion into, or utilization by U.S. submarines and undersea systems. USW CTO will pursue and promote new technologies addressing current, emerging and projected USW needs and will assist with the development of agreements for their development and transition to acquisition and in-service programs. USW CTO will also monitor S&T and research and development (R&D) investments and provide recommendations for change as needed.
- Naval Research & Development Establishment (NR&DE) - An association of Scientists and Engineers resident at the Naval Research Laboratory, Naval Warfare and Systems Centers, Federally Funded Research and Development Centers (FFRDC), University Affiliated Research Centers (UARC), colleges and universities, and innovative businesses and industry laboratories. These scientists and engineers conduct mission-oriented research and development on a broad spectrum of technical challenges posed by the Navy's operational environments, look to meet long-term emerging needs, mitigate the risk of technological surprise and focus on building knowledge through discovery and invention. The NR&DE provides innovative solutions and subject matter experts to support the USW S&T Strategy.

# Appendix A - References

## National Strategic Documents

- National Security Strategy
- The National Military Strategy of the United States of America
- Quadrennial Defense Review
- The National Strategy for Maritime Security

## Joint and Naval Strategic Documents

- Air Sea Battle: A Point of Departure Operational Concept
- Joint Operating Environment
- Joint Operational Access Concept
- Department of the Navy Objectives for FY 2012 and Beyond
- CNO Navigation Plan, 2016-2020
- CNO SSG XXXII Way Ahead Plan: Sustaining the Navy's Undersea superiority
- A Cooperative Strategy for 21st Century Seapower
- Naval Operations Concept
- Naval S&T Strategy
- Undersea Warfare Vision 2025
- Commander's Intent for the U.S Submarine Force and Supporting Organizations
- Integrated Undersea Future Investment Strategy (IUFIS)
- Naval Special Warfare S&T Strategic Plan (2009)
- Operation of the Defense Acquisition System, DoD Instruction 5000.2
- International Hydrographic Organization Geospatial Standard for Hydrographic Data

## Naval S&T Documents

- POM-18 Navy Technology Gaps
- Integrated Undersea Surveillance System S&T Objectives (ISTOs)
- Surface Enterprise Science & Technology Objectives
- Naval Aviation Enterprise Science & Technology Objectives
- Information Dominance Science & Technology Objectives

## Appendix B – Abbreviations & Acronyms

<b>A2AD</b>	Anti-Access/Area Denial
<b>AA</b>	Assure Access to Maritime Battlespace
<b>ASN (RDA)</b>	Assistant Secretary of the Navy for Research, Development and Acquisition
<b>ASuW</b>	Anti-Surface Warfare
<b>ASW</b>	Anti-Submarine Warfare
<b>AUS</b>	Autonomy and Unmanned Systems
<b>BOD</b>	Board of Directors
<b>CS-21R</b>	Cooperative Strategy for 21st Century
<b>CNO</b>	Chief of Naval Operations
<b>CNR</b>	Chief of Naval Research
<b>COMSUBFOR</b>	Commander, Submarine Force
<b>CTO</b>	Chief Technology Officer
<b>D&amp;I</b>	Discovery and Invention
<b>DEA</b>	Data Exchange Annex
<b>DARPA</b>	Defense Advance Research Project Agency
<b>DOD</b>	Department of Defense
<b>EIW</b>	Expeditionary & Irregular Warfare
<b>FCG</b>	Future Capability Group
<b>GTA</b>	Global Technology Awareness
<b>IDC</b>	Information Dominance & Cyber
<b>IEA</b>	Information Exchange Annex
<b>IUFIS</b>	Integrated Undersea Future Investment Strategy
<b>LOE</b>	Line of Effort
<b>NAVSEA</b>	Naval Sea Systems Command
<b>NIPO</b>	Navy International Programs Office
<b>NR&amp;DE</b>	Naval Research and Development Enterprise
<b>NUWC</b>	Naval Undersea Warfare Center
<b>ONI</b>	Office of Naval Intelligence
<b>ONR</b>	Office of Naval Research
<b>OPNAV</b>	Office of the Chief of Naval Operations
<b>OSD</b>	Office of the Secretary of Defense
<b>PE</b>	Power and Energy
<b>PEO SUB</b>	Program Executive Office, Submarines
<b>PDS</b>	Platform Design & Survivability
<b>POC</b>	Point of Contact
<b>POR</b>	Program of Record
<b>S&amp;T</b>	Science and Technology
<b>SDMG</b>	Ship Alt Development Modernization Group
<b>SID</b>	Strike & Integrated Defense
<b>SITG</b>	Submarine Information Technology Governance Group
<b>SPAWAR</b>	Space & Naval Warfare Systems Command

<b>SSG</b>	Strategic Studies Group
<b>STEED</b>	Science and Technology Executive Engagement Day
<b>STO</b>	Science and Technology Objective
<b>STRG</b>	Submarine Tactical Requirements Group
<b>TAB</b>	Transition Advisory Board
<b>TOG</b>	Technical Oversight Group
<b>TPO</b>	Technical Projects Officer
<b>UMW</b>	Undersea Maneuver Warfare
<b>USD</b>	Undersea Domain
<b>USE</b>	Undersea Enterprise
<b>USW</b>	Undersea Warfare
<b>UPNT</b>	Undersea Precision Navigation and Timing
<b>UUV</b>	Unmanned Undersea Vehicles
<b>WP</b>	Warfighter Performance



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# UNDERSEA WARFARE CHIEF TECHNOLOGY OFFICE

Enabling Strategic Innovation for the Undersea Force